Engineering Physics I
PHYS 1600

MWF 11:00-11:50 am

- **Instructor:** Dr. Turker Topcu
- **Office:** 115 Allison Lab
- **Office Hours:** Tue and Wed between 2:00-4:00 pm
- **E-mail:** topcut1@auburn.edu
- **Web page:** http://www.auburn.edu/topcut1/phys1600.htm

  Most of the class information will be posted through this web page.
- Syllabus and schedule on web page

Labs

- Once a week for 2 hrs and 50 mins
- First 50 mins review/weekly quiz
- Remainder of time will be used to perform weekly experiment
- There no lab manuals in print. **Print out and read** the lab manuals **<u>before</u>** coming to the lab

<u>First lab:</u> Prerequisite Math Quiz.

Depending on your score, you may receive an e-mail requesting a meeting. If you do not come and see me, this course ***will be dropped*** from your schedule.

Homework

***MasteringPhysics* Website**

http://www.masteringphysics.com/

- Register and create an account.
- Add this course to your account. The course ID is **TOPCUPHYS1600**
- There are tutorials on the website for how to use it for doing the homework
- Complete the Introduction to MasteringPhysics assignment to familiarize yourself with the use of the web site
- Students get feedback, hints, several chances to get the answer right etc.

Chapter 1. Concepts of Motion

Topics:

- The Particle Model
- Position and Time
- Velocity
- Linear Acceleration
- Motion in One Dimension
- Solving Problems in Physics
- Units and Significant Figures

What is a “particle”?

A. Any part of an atom

B. An object that can be represented as a mass at a single point in space

C. A part of a whole

D. An object that can be represented as a single point in time

E. An object that has no top or bottom, no front or back

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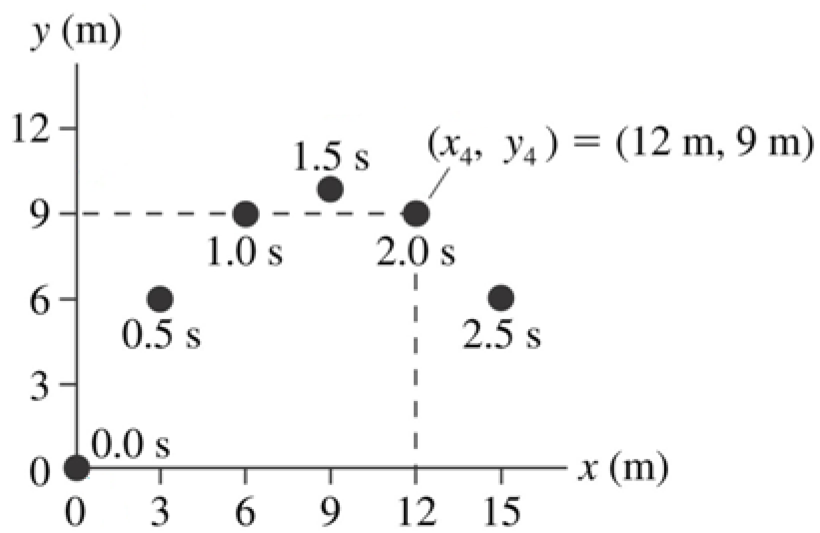
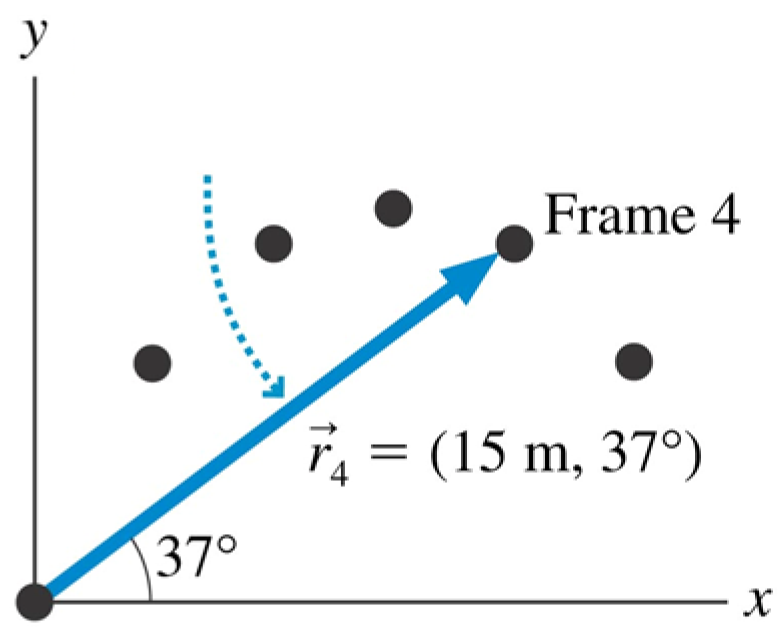
Position and Time

Position and time measurements done on the motion diagram of a basketball

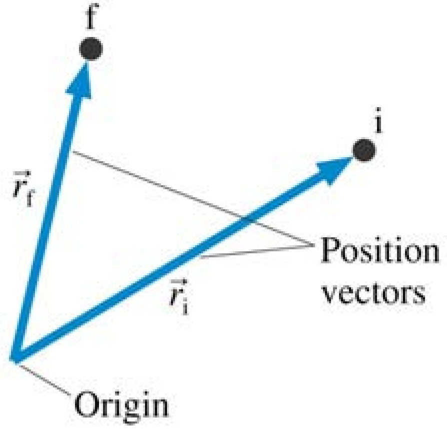


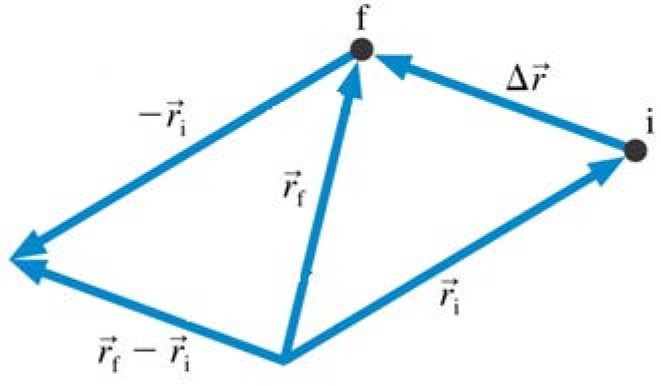


Position and Time

The displacement vector is $\Delta\vec{r} = \vec{r}_f - \vec{r}_i$

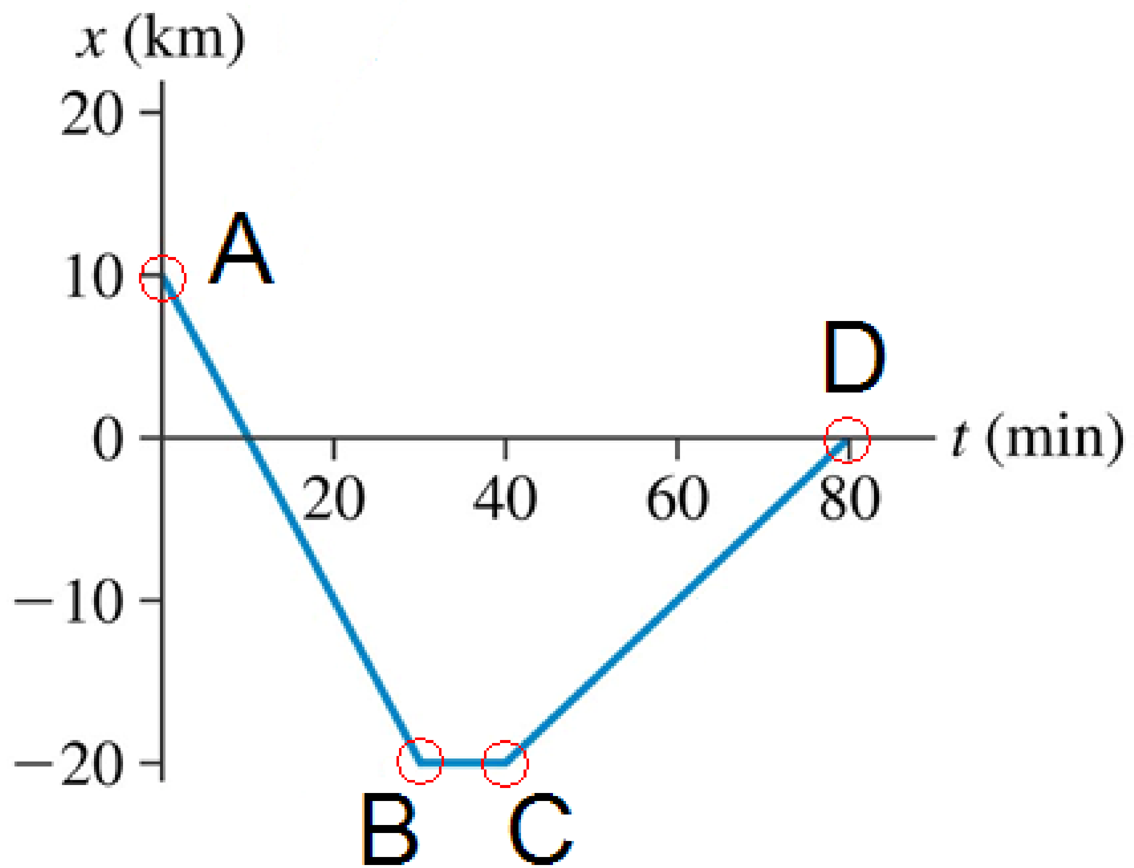
Change in time is $\Delta t = t_f - t_i$





Interpreting a Position Graph

Motion of a car along a straight road



Average Speed, Average Velocity

To quantify an object's fastness or slowness, we define a ratio as follows:

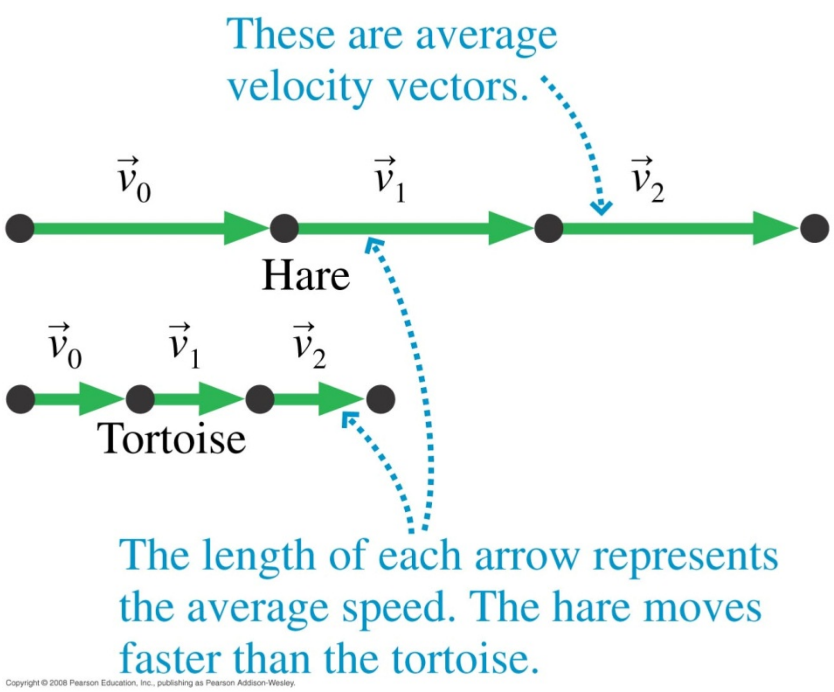
$$\text{average speed} = \frac{\text{distance traveled}}{\text{time interval spent traveling}}$$

Average **speed** is a **scalar** quantity.
Average **velocity** is a **vector** quantity.

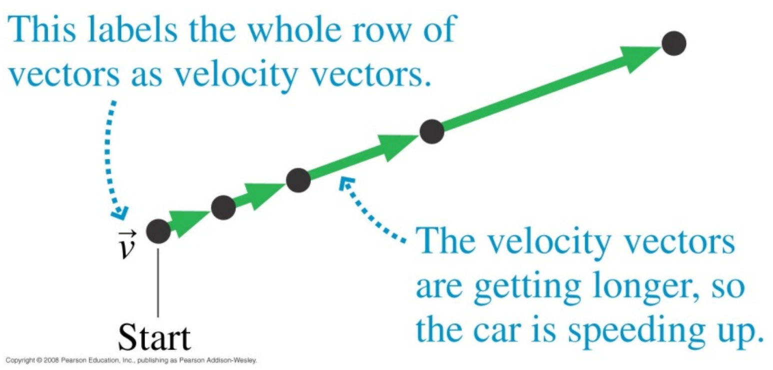
$$\vec{v}_{\text{avg}} = \frac{\Delta\vec{r}}{\Delta t}$$

Motion diagrams with velocity vectors

A tortoise racing a hare



A car accelerating up a hill



Linear Acceleration

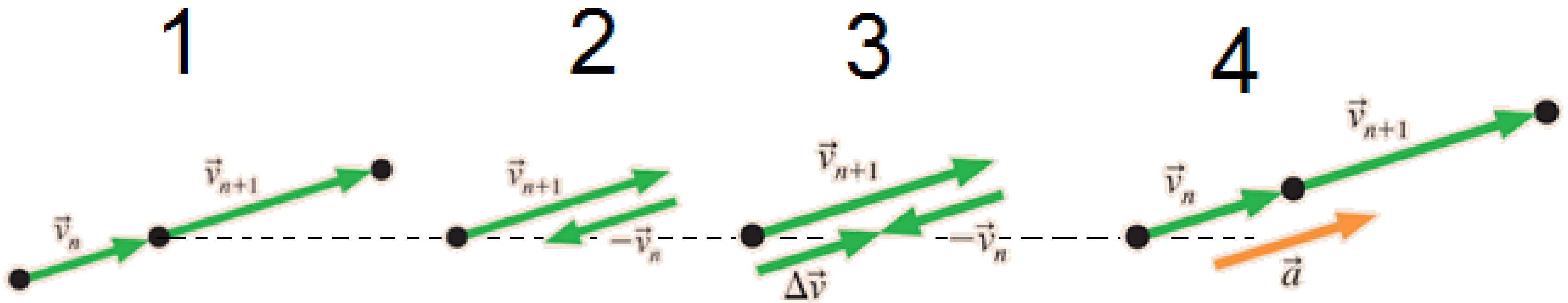
Because velocity is a vector, it can change in two possible ways.

1. The **magnitude** can change
2. The **direction** can change

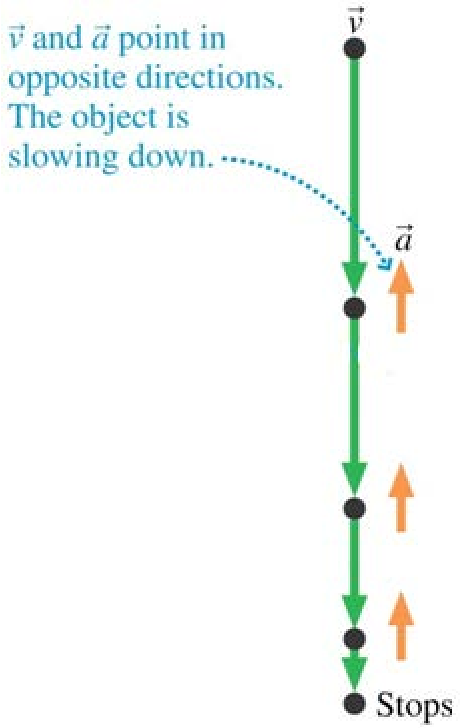
The average acceleration is $\vec{a} = \frac{\Delta\vec{v}}{\Delta t}$

Finding the acceleration vector

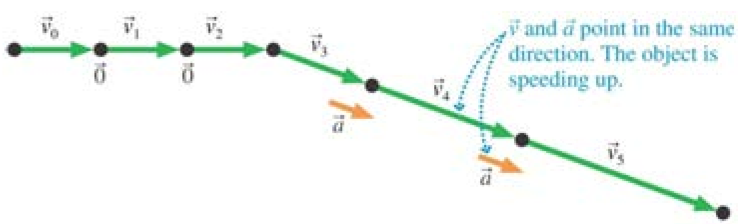
$$\vec{a} = \frac{\vec{v}_{n+1} - \vec{v}_n}{t_{n+1} - t_n}$$



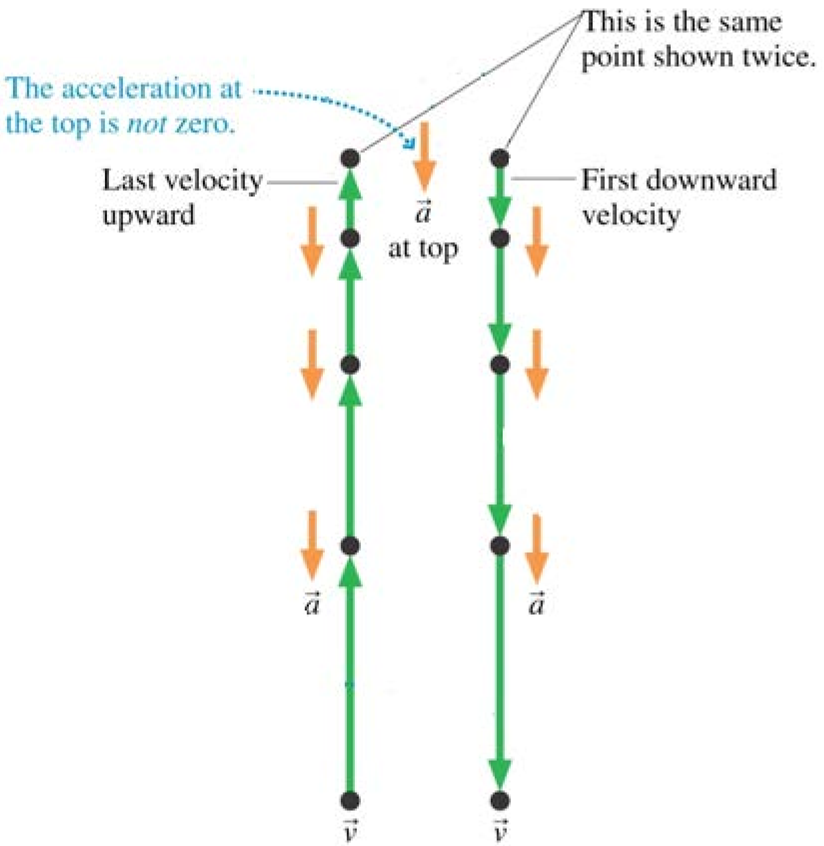
Landing on Mars



Skiing



Tossing up a ball



Units and Significant Figures

SI (formerly MKS) units:

Mass: **kg** Length: **m** Time: **s**

Units conversions

1. Write the conversion factor as a ratio equal to one

$$\frac{10^{-6}\ \text{m}}{1\ \mu\text{m}} = 1 \quad ; \quad \frac{2.54\ \text{cm}}{1\ \text{in}} = 1$$

2. Multiply the expression with the ratio to convert the units

$$3.5\ \mu\text{m} \times \frac{10^{-6}\ \text{m}}{1\ \mu\text{m}} = 3.5 \times 10^{-6}\ \text{m}$$

$$2.00\ \text{ft} \times \frac{12\ \text{in}}{1\ \text{ft}} \times \frac{2.54\ \text{cm}}{1\ \text{in}} \times \frac{10^{-2}\ \text{m}}{1\ \text{cm}} = 0.610\ \text{m}$$

Metric Prefixes

kilo- (k-)	10^{3}	1 thousand
centi- (c-)	10^{-2}	1 hundredth
milli- (m-)	10^{-3}	1 thousandth
micro- (μ-)	10^{-6}	1 millionth
nano- (n-)	10^{-9}	1 billionth
pico- (p-)	10^{-12}	1 trillionth
femto- (f-)	10^{-15}	1 quadrillionth

Units and Significant Figures

Leading zeros locate the decimal point. They are not significant.

$$0.00620 = \boxed{6.20} \times 10^{-3}$$

A trailing zero is reliably known. It is significant.

The number of significant figures is the number of digits when written in scientific notation.

- The number of significant figures ≠ the number of decimal places.
- Changing units shifts the decimal point but does not change the number of significant figures.

Rules for Significant Figures

- All nonzero digits are significant:
  - 1.234 g has 4 significant figures,
  - 1.2 g has 2 significant figures.
- Zeroes between nonzero digits are significant:
  - 1002 kg has 4 significant figures,
    3.07 mL has 3 significant figures.
- Leading zeros to the left of the first nonzero digits are **not** significant; such zeroes merely indicate the position of the decimal point:
  - 0.001 g has only 1 significant figure,
    0.012 g has 2 significant figures.
- Trailing zeroes that are also to the right of a decimal point in a number are significant:
  - 0.0230 mL has 3 significant figures,
    0.20 g has 2 significant figures.
- When a number ends in zeroes that are not to the right of a decimal point, the zeroes are **not** necessarily significant. Write the number in scientific notation remove ambiguity:
  - 50,600 calories may be 3, 4, or 5 significant figures.

  5.06×10^4 calories (3 significant figures)
  5.060×10^4 calories (4 significant figures), or
  5.0600×10^4 calories (5 significant figures).

Rules for Mathematical operations

- In **addition** and **subtraction**, the result is rounded off so that it has the same number of decimal places as the measurement having the fewest decimal places
  - 100 (assume 3 sig. fig.) + 23.643 (5 sig. fig.) = [123.643]

    = 124

- In **multiplication** and **division**, the result should be rounded off so as to have the same number of significant figures as in the component with the least number of significant figures.
  - 3.0 (2 sig. fig.) × 12.60 (4 sig. fig.) = [37.8000]

    = 38